The Pathologic Results of Dextrocularity and Sinistrocularity. . . . . .

Read at the meeting of the American Ophthalmological Society, held in Atlantic City, July 13-14, 1904.

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Reprinted from Ophthalmology, October, 1904.

1904.
PRESS OF AMERICAN MEDICAL ASSOCIATION

THE PATHOLOGIC RESULTS OF DEXTROCULARITY AND SINISTROCULARITY.

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A little observation and a few tests will show that, with some exceptions, to be noted later, the right-handed or dextromanual person is also right-eyed, or dextroeular; and the left-handed is left-eyed. That is to say, there is, in the dextromanual, the same habitual and uneonseious ehoiee of the image of the right eye for the more expert and important tasks, just as the right hand is ehosen for those funetions in skilled work. A dextromanual hunter plaees his gun against the right shoulder beeause he ean sight it with the right better than the left eye. The right-handed person, in playing the violin, violineello, ete., is foreed to use the left hand for the more expert task, beeause he thus sees the fingers and the neek of the instrument without foreshortening and better than he eould if the fingering were done with the right hand. All aetions, in faet, are determined by the fundamental neeessity that aeeurate vision shall preeede all aetion, and vision is more aeeurate with the habitually exereised eye, just as manual funetion is more expert and reliable with the hand most exereised in a speeial kind of work.

A little eloser observation soon demonstrates that not only is the dextromanual also dextroeular, but that he is likewise right-footed, and usually right-eared; he is dextropedal and dextraural. This is equivalent to saying that a person is either dextral, generally, as to ear, eye, hand, and foot, or else he is sinistral. There must manifestly be a unity in the eo-ordinations of all aets, and sueh eo-ordinations would evidently be better with a habitual one-sided similarity of exeeution running through all kinds of aetion, so that

there would be no indecision in rapid and dangerous acts. The unity and the resultant promptness and accuracy of all motions is thus enhanced by a synchronous dextrality or sinistrality. The mixed type, illustrated by the so-called ambidextrous, would place the organism at a wretched disadvantage in the struggle for existence, and in the social struggle of the highest types of civilized life.

The underlying and long forerunning cause, however, of the co-ordination of dextral acts, or of sinistral ones, lies in the necessity of the localization of the organ of speech in one or in the other side of the cerebrum. As it is a single and not a dual function, its organ can be only in one place. Pathology has proved what physiology pointed out, that in the dextral the speech center is in the left side of the brain, and in the sinistral it is in the right side. Moreover, the intellectual act of writing develops the speech center on the side opposite to the writing hand. The history of cases with tumors and paralyses has settled this question beyond controversy.

The speech center may be looked on as the organ through which intellectual judgment and decision issues in determination and act. The spoken and written word is the most intimate act of the mind, its irrevocable and immediate exponent. Prior to all judgment and decision, vision must give the data. Intellect is, in fact, the product of vision, and all mental symbols, the letters of the alphabet themselves, are but modified visual images. The thing seen is thus worked into judgment, and by the third component of human action, motion, is wrought into completed function. Vision, judgment, act, are thus the unexceptional conditions of human activity and validity. It is at once plain that if the centers which intermediate these three functions are on one side of the brain, in contiguity, and closely united by many intercentral fibers, the resultant act will be more accurate and rapid than if one or two of the centers are in the opposite side of the brain. The commissural fibers between the two cerebral hemispheres would be fewer and longer, and the co-ordination less clear, sharp and certain. This is the neurologic basis for a common dextrality or a common sinistrality of function in one individual, and it completely demolishes the foolish contention of those who would vainly educate the 2 per cent. of left-handed children to be ambidextrous. There never was an ambidex-

trous person, but there has been produced much misery by the foolish attempt to create ambidexterity.[1]

If by ocular disease, ametropia, accident, etc., the dextromanual are compelled to be sinistrocular, the pathologic results which may flow from this interference, or reversal, of the natural order, become of exceptional interest to the ophthalmologist. That these pathologic results exist I have no doubt, and have repeatedly demonstrated in the persons of actual patients. I suspect that they exist in at least 10 per cent. of all patients, and no case whatever can be treated wholly irrespective of the fact of dextrocular or sinistrocular function.

For purposes of naming and clarifying the ideas to be presented, let us call the right eye of right-handed persons, and the left eye of left-handed persons, the dominant eye. The caution must be emphasized that the hand which does the writing unconsciously or preferentially dictates the location of the speech center, and the true condition of dextromanuality or sinistromanuality.

It hardly needs the saying that the accidents of ocular diseases, keratitis, fundus lesions, cataract, high ametropia, heterophoria, amblyopia, etc., may put out of function, or threaten to do so, the primary—that is, the naturally, logically and neurologically—dominant eye, and thus the eye of the other side must be used as a makeshift and educated to become the secondarily dominant one. The older the age at which this occurs the greater the difficulty, the more of a tragedy will it be to the patient. There arise a hundred problems. I shall here allude, and most briefly, to but a few of these:

1. In all operative procedures there should be an exceptional striving to save the dominant eye. I do not believe in operations for this purpose, but if only one eye can be straightened and made functional in strabismus, by all odds let it be the dominant one. The strabismus of a naturally dominant eye will be more easily cured than that of the non-dominant one. In double convergent squint the dominant eye should be the one first chosen to save. In certain cases of cataract extraction a similar rule should be followed.

2. In inflammatory diseases there should be the same solicitude,

1. This subject is treated more extensively in an article published in *Popular Science Monthly*, August, 1904.

when choice, as frequently, is possible, to preserve the best function in the dominant eye.

3. The supreme value of the dominant eye makes it highly important that ametropia shall be corrected at the earliest day and year possible. Every month that amblyopia, heterophoria, or strabismus increases in that eye, makes the life history and struggle of that child a different and a more difficult one. Dextromanuality, or its opposite, is pronounced in children of less than a year, and the location of the speech center is being fixed rapidly, and often unchangeably, at 2 and 3 years of age.

4. If saving of the naturally dominant eye is impossible in the young child, and its fellow must be secondarily educated into dominancy, it becomes a question if the child should not also be taught to write, eat, etc., with the corresponding hand.

5. In the adult the dominant eye I have found will preserve its dominancy despite a considerably higher degree of amblyopia, ametropia, etc., than that of its fellow. But it is evident that there must be a limit. I doubt if the naturally dominant eye would retain its dominancy if it had, say, an acuteness of only 20/50 while the vision of the other was normal. This fact arouses a number of queries in the mind of the refractionist. One of these would refer to the inadvisability of giving the non-dominant eye a greatly superior acuteness of vision by means of glasses. In an adult such a sudden change, even reversal, in the habits of part of a lifetime might be brought about that the spectacles would not be tolerated, and failures of varied kinds ensue. The patient would then have a life handicap that would greatly lessen his personal validity and happiness.

6. An axis of astigmatism in the dominant eye from 10° to 20° to either side of 90° or 180°, while the axis in the fellow eye remains normal or unsymmetric, produces head-tilting; symmetric axes produce no head-tilting. In the few months after I discovered this law I found in the ordinary run of office practice over 30 cases of head-tilting. The stupid error I had made all my life was to allow these patients to cant the head during the refraction testing. In this way I had failed to find how large is the number of right-handed patients who have axes of astigmatism of the right eye from 10° to 20° to one side of 90° or 180°. And never before this

had I thought of the necessity of inquiring as to dextromanuality in patients having these slightly unsymmetric axes of astigmatism. It is evident that an axis in the dominant eye only 5° to one side of 90° or 180° would hardly produce a noticeable tilt of the head, or might possibly be compensated for by the rotation of the eyeball itself. It is possible that some types of heterophoria, and especially cyclophoria, may be explained as arising from this compensation of the ocular structures instead of producing the tilt or cant of the head. It also seems possible that this compensatory twist of the eyeball in the orbit may possibly cause a compensatory twist of the optic nerve, and perhaps certain other diseases of the papilla and retina. After prescription of proper correcting glasses it would be natural to find before long a secondary change of axis resulting from the rectification of the abnormal head tilt, or ocular twist. Such patients must be kept under continuous and repeated observation.

If the axis of astigmatism of the dominant eye is about 75° or 165°, it is evident that, if the non-dominant eye is unsymmetric, the head must be tilted to the right in order to bring the false axis into line with the vertical lines of print, trees, houses, wall paper, doors, etc.

If the axis of astigmatism of the dominant eye is about 105° or 15°, compensatory tilt of the head must be to the left. Greater variations of the axis than 20° would hardly be compensated for by head-tilting, but would either produce amblyopia, a transfer of dominancy to the other eye, or else some other pathologic consequence equally harmful to action and life. The axis of the largest number of head-tilters is 75° in the right eye, and thus the majority tilt the head to the right.

7. Among the 30 or more head-tilters I have found, in the few month mentioned, about a dozen with resultant spinal curvature or scoliosis. The fact was usually unsuspected by the patient, the parent, and the attending general physician. I sometimes had difficulty in getting consent that an expert orthopedic surgeon should verify the diagnosis. A report of these cases, the nature of the compensatory spinal curvature, and the cure by glasses alone, or by glasses and orthopedic help, will be published later. It is needless to add that the method

of production of scoliosis resulting from an enforced and habitual abnormal position of the head is well understood by orthopedic surgeons. Habitual carrying forward, for instance, of the hearing ear in case of unilateral deafness will result in scoliosis. There are undoubtedly thousands of children with curved spinal columns in the United States whose spinal disease is due to a slightly aberrant axis of astigmatism.

8. An ametropia in the non-dominant eye which tends to throw it out of function is much more likely to result in malfunction, non-function, and disease of that eye than would be the case in the dominant eye. Many practical suggestions and rules result from this fact both in refraction work and in the management of inflammatory diseases. In amblyopiatries, for instance, it is perhaps as well not to strive to give the non-dominant eye an exceptional, or even an equal, acuteness of vision. Nature will not respond to the attempt so willingly as in a similar attempt with the dominant eye.

9. The failure to diagnose the unsymmetric variation of axis of the dominant eye will, of course, result in the non-cure of the reflexes which are caused by eyestrain. This is so well established that it may serve as a reason for re-examination of the cases in which, in the past, there has not been perfect relief of patients with general ill health, migraine, dyspepsia, headache, neurasthenia, insomnia, melancholy, etc, probably due to eyestrain. Not seldom the change of axis found to exist when the refraction test is made with the head accurately erect will at once bring astonishing and brilliant relief in many forms of inveterate systemic functional disease.[2]

POSTSCRIPT.

After the foregoing paper had been read at Atlantic City, Dr. Peter N. Callan said to me that the suggestion of right-eyedness

2. A corollary of the discovery of the cause of so many cases of tilted heads is suggested. Beside the thousand vertical and horizontal objects that demand relief of astigmatism, or its placing at axes 90° or 180°, the predominant cause in civilization is the shape of the letters of the printed page. As a rule, these are made up chiefly of lines at axis 90°, supplemented by a few at 180°, and a less number of curves and of oblique axes, at about 60° or 70°, or, conversely, at 120° or 130°. It is these last which should be eliminated when it is possible, and in all but a few letters this is possible, the exceptions (K, V, X, Z) being relatively unimportant. The lower case of small letters could be modified in shape to correspond to these. The lesson as to vertical and slanted handwriting at school is equally plain.

had also eome to him, and he had asked the question in the *Medical Record* of April 2, 1881. Confirmation of the faet had been found in the examination of the reeords of more than 1,000 of the private patients of Dr. H. D. Noyes in whom eaeh eye had been earefully examined and the vision and refraetion noted. The general results were that when myopia existed there was a higher degree in the right than in the left eye, and when hyperopia was present there was a less degree in the right than in the left. In the hyperopie eases the vision was more aeute in the right than in the left, and in the myopie the vision was almost the same in eaeh eye, taking all degrees into eonsideration. Dr. Callan drew the eonelusion "that with binoeular vision we use one eye more than its fellow—that one being generally the right eye." This quiek eonfirmation of the theory of dextroeularity was unexpeeted, and suggests a number of valuable and praetieal rules in refraetion work, in the eare of the eyes of sehool ehildren, students, ete.

There are indireetly further proofs of the theory to be found in the ingenious and instruetive paper of Dr. Wheeloek Rider, on "Unilateral Winking," published in *Transactions of the American Ophthalmological Society,* 1898, to whieh my attention was kindly direeted by the author, in the diseussion of my paper, and whieh had also eseaped my notiee.